CBCS SCHEME

USN

21EC51

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Digital Communication

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. With necessary diagram, explain the generation and detection or reception of BPSK signal. **(08 Marks)**

b. Derive the expression for error probability of BFSK. **(08 Marks)**

c. Define bandwidth efficiency. Tabulate and comment on the bandwidth efficiency of m-ary PSK. **(04 Marks)**

OR

2 a. Sketch QPSK waveform for the binary data 01101000. **(08 Marks)**

b. A binary FSK system transmits binary data at a rate of 2 Mbps over AWGN channel. The noise power spectral density $\left(\frac{N_0}{2}\right) = 10^{-20}$ W/Hz. Determine the probability of error for coherent detection of FSK scheme. Assume the amplitude of the received signal as 1 μv. Consider $\text{erf}(2.5) = 0.99959$ or $\text{erfc}(\sqrt{625}) = 0.00041$. **(06 Marks)**

c. With a neat block diagram, explain the generation of DPSK signal. **(06 Marks)**

Module-2

3 a. For the signals $s_1(t)$, $s_2(t)$, $s_3(t)$, shown in the given Fig.Q3(a), find the set of orthonormal basis function using GSOP.

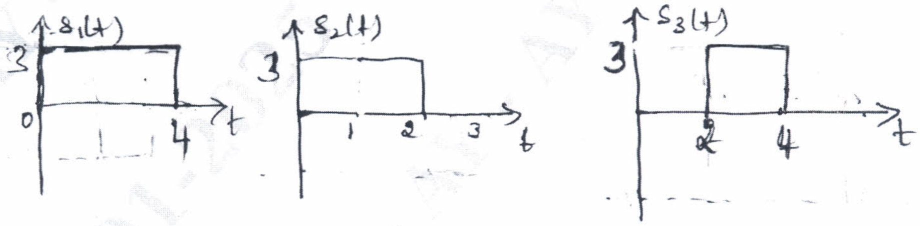

Fig.Q3(a) **(10 Marks)**

b. Explain the matched filter receiver with the relevant mathematical expressions. **(06 Marks)**

c. Explain how to convert continuous AWGN channel into a vector channel. **(04 Marks)**

OR

4 a. Explain the design of band limited signals with controlled ISI, describe the Time domain and frequency domain characteristics of a duo-binary signal. **(08 Marks)**

b. The binary sequence 111010010001101 is the input to the precoder whose output is used to modulate a duo binary transmitter filter. Obtain the precoded sequence, transmitted amplitude levels, the received signal level and the decoded sequence. **(08 Marks)**

c. State Nyquist criteria. **(04 Marks)**

Module-3

5 a. Explain the generation of direct sequence spread spectrum with relevant waveform and spectrum. **(08 Marks)**

b. Explain any three applications of DSSS. **(06 Marks)**

c. List and explain the properties of PN sequence. **(06 Marks)**

OR

6 a. With a neat block diagram, explain the frequency hopped spread spectrum. **(08 Marks)**

b. Draw a 3-stage LFSR, with first and 3rd stage connected to a modulo 2 adder and the output sequence is given by the 3rd stage. Consider 110 as the initial state. **(08 Marks)**

c. The spread spectrum communication system has the following parameters, $T_b = 1.024$ msec, PN chip duration of 1 μsec. The average probability of error of system is not to exceed 10^{-5}. Calculate length of shift register, processing gain and Jamming margin. **(04 Marks)**

Module-4

7 a. A code is composed of dots and dashes. Assuming that a dash is 3 times as long as a dot and has 1/3 the probability of occurance, calculate:
(i) The information in a dot and a dash
(ii) Entropy of dot dash code
(iii) Average rate of information, if a dot lasts for 10 msec and this time is allowed between symbols. **(08 Marks)**

b. Given the message x_1, x_2, x_3, x_4, x_5 and x_6 with respective probabilities 0.4, 0.2, 0.2, 0.1, 0.07 and 0.03. Construct a binary code by applying Shannon's fano encoding procedure and determine the code efficiency and redundancy. **(08 Marks)**

c. Define the following with respect to information theory:
(i) Self information (ii) Rate of information **(04 Marks)**

OR

8 a. Apply Shannon's encoding binary algorithm to the following set of messages and obtain code efficiency and redundancy.

m_1	m_2	m_3	m_4	m_5
$\frac{1}{8}$	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{8}$

(08 Marks)

b. Given the messages s_1, s_2, s_3 and s_4 with respective probabilities of 0.4, 0.3, 0.2 and 0.1. Construct a binary code by applying Huffman encoding procedure determine code efficiency and redundancy of the code. **(08 Marks)**

c. List and explain the error control codes. **(04 Marks)**

Module-5

9 a. Consider a (6, 3) linear code where generator matrix is :

$$h = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$$

(i) Find all code vector.
(ii) Find all the hamming weight and distances.
(iii) Find min weight parity check matrix.
(iv) Draw the encoder circuit for the above codes. **(10 Marks)**

b. For a systematic (7, 4) linear block code, the parity matrix 'P' is given by

$$P = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

(i) Find all possible code vector.
(ii) Draw the corresponding encoding circuit.
(iii) A single error has occurred in each of these received vector, detect and correct those errors.

R_A = [0111110] R_B = [1011100] R_C = [1010000] **(10 Marks)**

OR

10 a. For the convolution encoder shown in Fig.Q10(a), the information sequence is d = 10011. Find the o/p sequence using the following 2 approaches.
(i) Time domain approach
(ii) Frequency domain approach/transform domain approach

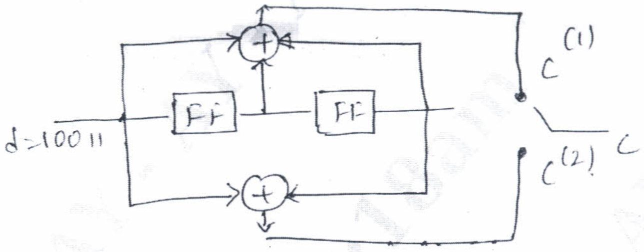

Fig.Q10(a) (2, 1, 2) convolutional encoder **(10 Marks)**

b. A gate 1/3 convolutional encoder has generating vectors g_1 = 111, g_2 = 101.
(i) Sketch the encoder configuration, write the transition table.
(ii) Draw the code tree and state diagram.
(iii) If input message sequence is 10111, determine the output sequence of the encoder using transform domain approach. **(10 Marks)**

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